

DOCUMENT RESUME

ED 186 256

SE 030 640

AUTHOR Smith, Victor A.; Iane, Kathleen Buddy
 TITLE An Evaluation of the Energy Education Curriculum
 Project Materials in Indiana Elementary Schools.
 PUB DATE Apr 80
 NOTE 59p.; Paper presented at the annual meeting of the
 American Educational Research Association (Boston,
 MA, April 7-11, 1980).

EDRS PRICE MF01/PC03 Plus Postage.
 DESCRIPTORS *Curriculum Development; Educational Assessment;
 *Educational Research; *Elementary Education;
 *Energy; Energy Conservation; Environmental
 Education; *Evaluation; Interdisciplinary Approach;
 Research; *Science Education; Surveys
 IDENTIFIERS *Energy Education

ABSTRACT

Presented is the evaluation of a K-6 collection of
 energy education materials developed to be used primarily with social
 studies and science classes. The objectives of the evaluation were
 two-fold: (1) to formatively evaluate the lessons to provide further
 direction for development and revision; and (2) to summatively
 evaluate the use of the materials by teachers and the impact of the
 materials on students and teachers. (Author/RE)

 * Reproductions supplied by EDRS are the best that can be made *
 * from the original document. *

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Victor A. Smith
Kathleen R. Lane

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

An Evaluation of the Energy Education
Curriculum Project Materials
in Indiana Elementary Schools

Dr. Victor A. Smith
Coordinator of Curriculum Research and Evaluation

Kathleen Ruddy Lane
Energy Education Consultant

Division of Curriculum
Indiana Department of Public Instruction
229 State House
Indianapolis, IN 46204

A paper presented at the Annual Meeting of the American Educational
Research Association, April, 1980, Boston

ED186256

SE 030 640

An Evaluation of the Energy Education
Curriculum Project Materials
in Indiana Elementary Schools

Dr. Victor A. Smith and Kathleen Ruddy Lane
Indiana Department of Public Instruction

During 1978-79, the Division of Curriculum of the Indiana Department of Public Instruction undertook a project to develop, disseminate and evaluate energy education materials for grades K-6. An Energy Curriculum For The Elementary Grades (1979) was developed to be used primarily with social studies and science classes. This curriculum consisted of 18 lessons for each of three levels: Unit One for grades K-1, Unit Two for grades 2-3, and Unit Three for grades 4-6.

The project followed a cyclical development process of testing and revision as synthesized in Schaffarzick and Hampson (1975). Evaluation was a process that occurred throughout the development process incorporating both formative and summative dimensions. The main purpose of the evaluation activities was to provide information for decision-making and to assess the effectiveness of project decisions. Although the efforts described in this paper drew on traditional evaluation models, the context of the project was a major factor in determining the direction of evaluation activities (Steele, 1977).

The purpose of this paper is to report on the evaluation of this project. The objectives of this evaluation were twofold:

- 1) to formatively evaluate the lessons to provide further direction for development and revision, and
- 2) to summatively evaluate the use of the materials by teachers and the impact of the materials on students and teachers.

The Energy Education Curriculum Project was a statewide effort by the Department of Public Instruction supported by the Indiana Department of Commerce Energy Group. The project staff coordinated the publication, dissemination and inservice training components of the project along with the evaluation efforts reported in this paper. The lessons themselves were developed under contract by a team from the Social Studies Development Center at Indiana University headed by Dr. Judith Gillespie.

Four main goal areas were reflected in the objectives for An Energy Curriculum for the Elementary Grades: awareness, information, inquiry skills and habits of participation. Awareness goals included interest, recognition and concern about energy resources, uses, and problems. Information goals included knowledge about human and physical resources, actions and outcomes. Inquiry skills included asking good questions, gathering evidence, valuing, and identifying future trends and alternatives. The goal of participation habits included improving consumer habits and citizen participation habits in energy decisions.

Collectively, all of the lessons at each level were designed to reach the goals of awareness, information, inquiry skills and habits of participation. Each lesson consisted of a rationale, objectives, learning activities, and a variety of stories and illustrations designed to appeal to students at all levels. Each lesson also included teaching suggestions or adaptations for use in math and language arts instruction. Each chapter of each unit concluded with assessment activities.

The energy education materials were designed to be used flexibly. Each lesson was outlined in rather rich detail with some sequential development. However, because the lessons provided a variety of activities along with adaptations for grade levels other than those addressed, elements of teacher discretion and decision-making were built into the materials.

An Energy Curriculum for the Elementary Grades was designed to be a voluntary and supplemental program which could be integrated into current school programs, thus meeting an urgent and timely curricular need.

Concurrent to the evaluation efforts reported in this paper, dissemination and inservice activities also took place. As of January, 1980, 12,000 individual units were disseminated in Indiana, throughout the nation and to foreign countries such as Malaysia, Israel, Great Britain, Canada, Australia, Venezuela, France and Colombia. Approximately 2,000 Indiana elementary educators have attended regional or local inservice sessions to learn about An Energy Curriculum for the Elementary Grades and to participate in implementation planning. The primary inservice effort related to this study was a series of ten initial dissemination workshops held in the fall of 1978. These regional workshops, attended by 324 educators, were designed to introduce project materials.

Evaluation Design

An evaluation design was developed which focused on both formative and summative dimensions. The audience for the formative evaluation was the development team. The audiences for the summative evaluation were expected to include funding agencies, school boards, school administrators, classroom teachers, energy educators, and the general public.

The design of the formative evaluation involved two techniques used in an iterative procedure: review by an interdisciplinary panel and classroom pilot testing. Based on the conceptualization paper which guided the project, the developers were to prepare the first draft of Unit One lessons. The panel composed of consultants with backgrounds in elementary education, early childhood education, science education, social studies education, environmental education, home economics, and evaluation would then read the lessons and meet with the developers to share their critiques of the procedures, activities and content of the lessons. The panel also included a representative of the Indiana Energy Group who was in charge of education activities for that office. Based on this evaluation, the developers would then revise the lessons and prepare several prototype lessons for classroom pilot testing. Due to the tight time schedule, pilot testing was scheduled for summer school. After hearing the pilot teacher assessments, lessons were to be revised and submitted again to the panel for final review before publication. The same cycle would be followed to formatively evaluate the lessons in Unit Two and Unit Three. Again, because of the tight timeline, cycles to develop the three units would necessarily overlap, with work beginning on Unit Two as Unit One was being reviewed. This repetitive framework of review and classroom testing was designed to provide the developers with as much formative data as possible in preparing useful, accurate and workable lessons for elementary classrooms.

The design of the summative evaluation involved two data sources: teacher questionnaires and student measures. Participants in the initial dissemination workshops held in the fall of 1978 would complete a questionnaire about energy education and also a workshop evaluation form. Teachers from this group would be sent a follow-up questionnaire in the spring of 1979 to determine the level of use of the materials and the perceptions teachers had of the materials after using them.

Secondly, the impact of the materials on students would be studied in the spring of 1979 in a pretest/posttest treatment/control design. Teachers who had attended the initial workshops and who represented a variety of grade levels and geographic settings would be sought to participate in the study.

Thus, a design organized around formative and summative evaluation was projected. Further details about the implementation procedures and the results of each phase are discussed below.

Formative Evaluation: Procedures and Results

Implementation of the formative evaluation procedures occurred basically as outlined above in the statement of the design. The review panel representing eight viewpoints met regularly with the development team as drafts for units were prepared. After revisions prompted by the panel critiques, lessons were tested in several classrooms. Seeking pilot teachers during summer school presented some difficulties and contributed to a smaller sample than had been planned. Twelve participating teachers in six Indiana cities completed a lesson response form about each lesson taught. They also completed a general response form, pertaining to the entire set of prototype lessons they used with their students. Due to slippage in the time schedule, lessons for the final unit were pilot tested early in September during the beginning of the new school year. Discussions were held between each pilot teacher and project staff either through personal interviews or by telephone. Results of these discussions and the written teacher responses to the lessons and to the general approach were given to the development team to assist in the revision process. Copies of the response forms given to pilot teachers are included in the appendix. The questions included in these forms were prepared jointly by the project staff and the development team in order to address the concerns of all parties.

In addition, students in some classrooms completed a pretest and a posttest in connection with the lesson trial. A quickly devised assessment form was used which included questions about the awareness, information, inquiry skills and participation of students. The effort was included in the pilot testing in order to provide a rough preliminary judgment of the effectiveness of the lessons with students.

As a result of the formative evaluation, the draft materials were substantially revised. Initial classrooms tests involving teacher responses and student assessments indicated that the lessons were not appropriate for younger students or for lower ability students because of the difficult reading level and the heavy conceptual load. This, in addition to numerous suggestions by the review panel, resulted in a complete reconceptualization of the content and sequencing of the energy lessons. Instead of basing each of the three units on a theme, with suggested adaptations for different grade levels, each unit was reformulated to be age specific, with Unit One designed for grades K-1, Unit Two designed for grades 2-3, and Unit Three designed for grades 4-6. This fundamental change in the materials resulted from an interaction of data received from both elements of the formative evaluation, the review panel and classroom tests.

The elementary teachers participating in subsequent pilot tests of the reformulated Unit Three indicated that the approach was now on the right track. In addition, assessments completed in two classrooms showed some encouraging changes between pretests and posttests. For example, students expressing a greater than average interest in studying the energy problem jumped from 36% to 56%. Those who thought they should know "a lot" about the energy problem increased from 57% to 78%. Those who knew that coal is a fossil fuel changed from 25% to 64%. The fact that "most oil comes from the Middle East" was recognized as true by 32% before the lessons and by 71% after the lessons. Before the lessons only 49% agreed that, "We may not use cars as much because of energy problems," whereas 80% agreed after the lessons. Time did not permit either validation of the instrument used, testing in large numbers of classes, or elaborate use of the results. Instead, this brief assessment

and results with a few classes were used by the developers as simply one more piece of evidence useful in deciding how to revise the materials.

The diverse backgrounds represented on the review panel proved to be very helpful to the developers in revising the materials. Conflicts often arose between subject matter specialists (science, social studies) and age-level specialists (early childhood and elementary) regarding the appropriate content and methodology of the lessons. The joint meetings of these specialists and the developers provided a forum to reconcile several different points of view and suggest mutually agreeable guidelines for the developers to use in revising materials. In hindsight, the succession of meetings with the review panel played an indispensable role in the creation of useful lessons within the tight time schedule.

Summative Evaluation: Teacher Outcomes

Procedures And Results

Implementation of the summative evaluation procedures to assess teacher outcomes involved the use of three questionnaires. Items from the three instruments were used to answer five evaluation questions related to teacher use and perceptions of the materials:

1. Were materials about energy viewed by workshop participants as something needed for their teaching situations?
2. Did the materials leave a positive first impression on those attending the initial dissemination workshops?
3. To what extent did workshop participants use the materials?
4. To what extent did the lessons fulfill the need for energy materials expressed by participants at the initial dissemination workshops?
5. Were teachers personally enthused about using the lessons?

The first questionnaire, used to answer the first evaluation question stated above, was administered as the opening activity at each of ten regional energy education workshops held in October and November, 1978. These initial dissemination workshops sponsored by the Department of Public Instruction were intended to introduce the project and to acquaint teachers and administrators with its goals and activities. The 324 workshop participants responded to a question about the need for energy materials, in answer to the first evaluation question, along with several other questions asked for other purposes. Later in the program, participants were given twelve sample lessons, four from each unit, to examine and discuss. It was hoped that teachers would try the lessons with their students and subsequently try more of the lessons when the entire publication was completed and distributed.

At the end of each workshop, participants completed a workshop evaluation form which had fifteen Likert-type questions along with some open-ended questions. The instrument is included in the appendix. Responses to five of the questions (numbers 3, 4, 6, 7, 8) were used to answer the second evaluation question stated above, regarding first impressions of the materials. A total of 306 participants completed the evaluation form.

The last three evaluation questions were explored using data from the third questionnaire, a follow-up survey mailed in May, 1979, to the 258 classroom teachers who had attended the fall workshops. An identical second questionnaire was mailed to home addresses in June to all teacher participants who had not returned the first questionnaire. A total of 154 (60%) of the teacher participants returned the survey.

Survey questions focused on use of the sample materials and perceptions of the materials. The follow-up survey is included in the appendix. Responses to five items (numbers 1, 2, 5, 6, 7) provided data to answer the third evaluation question regarding use of the materials. Similarly, items 8, 10, 12, 14, 16, 18, 19, and 21 were used in answering the fourth evaluation question about perceptions of the adequacy of the materials. The fifth question regarding teacher enthusiasm was examined using items 4 and 20.

Questionnaire Development

The first questionnaire was designed by the research and evaluation coordinator from the Division of Curriculum and a professor from the School of Education at Indiana University-Bloomington who was interested in and knowledgeable about energy education. The two questions of interest on this questionnaire related to the perceived need for energy materials, as specified in the first evaluation question.

The workshop evaluation form was designed by the research and evaluation coordinator in consultation with the energy education consultant. A Likert-type format was used which was consistent with the format generally used in the Division of Curriculum for evaluating in-service workshops.

The follow-up questionnaire was designed by the energy education consultants and research and evaluation coordinator from the Division of Curriculum with input from the professor involved in the first questionnaire. Fifteen items assessing use of and perceptions about project materials formed the data base for answering evaluation questions 3-5 stated above.

Both the first questionnaire and the follow-up questionnaire went through several revisions and were then pilot tested by several consultants in the Division of Curriculum, some of whom were familiar with the project and others who were not. A final revision based on these trials was made before using the questionnaires.

Limitations

There were several limitations to this part of the study. The primary limitation was that the information was gathered from three self-report questionnaires. Direct observations of classrooms for a lengthy period of time would have provided more objective assessments of actual use of project materials. Secondly, since the third questionnaire was mailed to participants, it is likely that those who returned the questionnaire had more positive responses about use of the materials than those who did not return the instrument. Also, since time constraints did not allow more than one follow-up, the return rate of 60% on the mailed questionnaires was not as high as possible. The respondents to the questionnaires voluntarily attended an initial dissemination workshop. Therefore, the results cannot be generalized to all teachers who received the energy materials but did not attend a training session. Finally it should be remembered that teachers completed the follow-up questionnaire based on the use of the twelve sample lessons distributed at the initial workshops. The entire set of fifty-four lessons in An Energy Curriculum for the Elementary Grades was distributed during the following summer.

Results

Three data collection efforts were described above which related to the evaluation of the use of the materials and the impact the materials had on teachers. Results will be reported in the context of the evaluation questions related to these three efforts.

1) Were materials about energy viewed by workshop participants as something needed for their teaching situation?

Participants at the dissemination workshops were asked, "To what extent do you need materials to help you teach about energy?" Of the 316 respondents, 75% replied "greatly needed" and another 22% replied "somewhat needed." Only 2% answered "slightly needed", and 1% answered "not needed at all." These responses came predominantly from educators who had little previous experience teaching energy lessons before. Of the 322 answering a question about previous use of energy lessons, 30% had not taught any before and 48% had "taught a few lessons on energy." Only 6% had "taught an energy course," and 16% had "taught many lessons on energy but not an energy course." Thus, these project lessons were being presented to educators who perceived a great need for energy materials but who were largely inexperienced in teaching about energy.

2) Did the materials leave a positive first impression on those attending the initial dissemination workshops?

Those attending the workshops in the fall of 1978 answered five questions on the workshop evaluation form which reflected their first impression of the materials. A total of 306 participants completed evaluation forms. Agreement with the item was defined as a response of either "agree" or "strongly agree" on the five-point likert-type scale. Responses to all five questions pointed to a positive impression.

A large majority of participants agreed that "these lessons fit in with the curriculum in our school" (77%), that "these lessons would go over well in our community" (74%), and that "these lessons seem easy to understand and use" (89%). In addition, 93% agreed that "it would be easy to try out a few of these lessons in my school," and 90% said they "plan to use the lessons in my class or school." Clearly, the materials made a positive impression during the one-day introductory workshops.

3) To what extent did workshop participants use the materials?

Several items on the follow-up questionnaire described the use of the materials. Of the 154 returning the mailed questionnaire, 63% reported that they had taught at least four of the sample lessons, the maximum number available for their grade level. Another 12% had used from one to three lessons, while 25% had not used any lessons.

When asked about the time spent teaching the sample lessons during 1978-79, a similar picture emerged. A total of 56% spent four or more hours with the lessons, while 25% reported they spent one to three hours and 19% reported zero hours.

The largest number of teachers (34%) reported that they used the sample lessons as combination social studies and science lessons. A number almost as large (31%) replied that the lessons were primarily used for teaching science, and another 21% reported primarily using them to teach social studies. On this question asking in which subject area lessons were taught, only 11% answered "none".

The lessons had suggested ways that activities could be adapted to teach mathematics and language arts. Results from the follow-up questionnaire indicated that these adaptations were seldom used. Only 4% reported using the math adaptations with four or more lessons, 21% used them with one to three lessons, and 75% reported they did not use the math adaptations.

The language arts adaptations were slightly more useful to teachers: 7% used them with four or more lessons, 36% used them with one to three lessons and 57% reported no use. Thus, while a large majority reported using the lessons in teaching science or social studies, only a small minority made use of the mathematics and language arts adaptations.

4) To what extent did the lessons fulfill the need for energy material expressed by participants at the initial dissemination workshops?

As described earlier, participants at the initial dissemination workshops had expressed a great need for materials about energy. Several questions on the follow-up questionnaire reflected on the degree to which these materials fulfilled that perceived need. On these questions, respondents answered using a seven point scale ranging from "Definitely No" (1) to "Definitely Yes" (7). Responses of 5, 6 or 7 were considered to indicate some degree of agreement. Using this procedure, 77% agreed to some degree that "the goals of the Energy Education Curriculum Project lessons" were "in line with the major curriculum goals of your district." Similarly, 83% agreed to some degree that the lessons were appropriate for the abilities of their students, and 84% agreed that the lessons were relevant to the backgrounds of their students. When asked if they are likely to use these energy lessons next year, 91% agreed. Clearly, these materials are at least partially fulfilling the perceived need.

Further evidence of this was found in responses to the question, "During this past school year, have you requested or ordered instructional materials about energy other than materials from the Energy Education Curriculum Project?" Many suggestions for other materials were included in the workshops and a bibliography of instructional materials was later mailed to each participant, so it was somewhat surprising that only 43%

reported that they requested other materials. The other 57% either felt that these lessons filled their needs or else lacked the time, money or initiative to secure other materials. Whatever the reason, the result seems to be that among a group that expressed a great need for energy materials, over half requested no other materials besides An Energy Curriculum for Elementary Grades. While 86% of those who used the lessons modified them for their situation, this seems to be an implementation strategy rather than an expression of disinterest since over 90% of the respondents indicated they are likely to use the lessons during the next school year.

Two additional responses by the 102 teachers who had used the sample lessons provided further evidence that the materials met the need for lessons which are effective with students. First, when asked, "Have the energy lessons affected the energy attitudes of your students?", 86% agreed to some degree, including 10% who replied "Definitely Yes." Similarly, 90% agreed to some degree that students reacted favorably to the energy lessons, including 25% who answered "Definitely Yes."

Thus, these results provide generally strong evidence that the lessons fulfilled a need for materials which were perceived by teachers to be appropriate to student backgrounds and abilities, which aligned with the district curriculum, and which were effective with students. In short, they fulfilled a need for materials which teachers would use.

5) Were teachers personally enthused about using the lessons?

Two additional questions on the follow-up questionnaire reflected the personal feelings teachers had about the materials. First, teachers who had taught the lessons were directly asked, "Did you enjoy teaching the lessons from the Energy Education Curriculum Project?" A total of 95% responded positively, including 31% who replied "Definitely Yes."

Secondly, respondents were asked if they shared any of the materials with other teachers at their school. The largest number (22%) responded "Yes, with the entire staff." Sharing with five to ten others was reported by 6%, with three to four others by 19%, with two others by 20%, and with one other by 17%. Only 16% reported that they did not share the materials with other teachers. Thus, both questions reflected positive responses toward the materials by a large majority of teachers, with around 30% expressing the most enthusiasm in teaching the materials and in sharing the materials with other people.

Summative Evaluation: Student Outcomes

Procedures and Results

As a part of the summative evaluation of the project, consultants of the Division of Curriculum planned to conduct a study of the effectiveness of the project materials with students. It was also felt that the Indiana Energy Group was interested in seeing firm evidence that the project was meeting the goals that had been set. Therefore, an impact study was conducted to assess student growth as a result of studying six lessons from An Energy Curriculum for the Elementary Grades. The study was designed to measure the results of the project materials as objectively and accurately as possible. The specific research questions to be answered by this study were as follows:

1. Did students who studied the energy lessons differ significantly from comparison students on the knowledge test?
2. Did students who studied the energy lessons differ significantly from comparison students on the attitude measure?
3. Did students who studied the energy lessons differ significantly from comparison students on the participation measure?

To answer these questions, a study was designed which would allow comparison between students who studied the lessons and those who had not. A pretest/posttest, treatment/control design was employed (Campbell and Stanley, 1963). Six teachers used six lessons with their students between the tests, while six other teachers gave the tests, but did not teach any energy lessons.

Sample Selection

Six teachers who had attended the Fall workshops and who had indicated an interest in participating in an evaluation study were selected

to participate. Two teachers from different locations participated in the study of each level: K-1, 2-3 and 4-6. For each of these teachers, cooperating teachers were found at the same school and grade level, and their students provided a control group for comparison purposes. Locations were selected so that urban communities and suburban or small town communities would be represented. The six communities selected ranged in size from Indianapolis with a population of over 710,000 to Whiteland with a population of 2000.

In May, 1979, the six teachers taught six lessons from An Energy Curriculum for the Elementary Grades to their students after giving a pretest. The comparison teachers also gave a pretest, but did not use the energy lessons with their students. After approximately four weeks, the same test was given to all 289 students as a posttest.

Measurement Instruments

The two energy education consultants and the research and evaluation coordinator of the Division of Curriculum designed the measurement instruments.* After carefully examining the lessons, it was decided that the awareness, information and inquiry skill domains were cognitive areas which could be assessed on a knowledge test utilizing both recall and application items. Habits of participation could be assessed through self-report items on energy conservation practices. It was also decided to include items to assess attitudes about energy and energy conservation since this seemed to be a prerequisite to habits of participation.

Regarding the measure of participation used in the study, it should be noted here that self-report questions to measure participation are at

*Special acknowledgement is due to Margaret Van Gundy of the Division of Curriculum for her help in designing the instruments used in this study.

best an inferior substitute for actual observation of behavior. Teachers did report observing behavior changes during the study; for example, some students began using both sides of the paper for coloring. However, the paper-and-pencil self-report on participation was written in an attempt to systematically collect information about how all students in the study participated in energy conservation activities. The unknown accuracy about self-reports must be remembered as a limitation in the measurement of participation.

Items were written to specifically address content found in the six lessons to be taught by the teachers in the study. Different items were devised for each level, resulting in three separate tests composed of 20 items, 30 items, and 40 items, respectively. A panel of consultants from the Division of Curriculum then assessed the content validity of the instruments, leading to a thorough revision. The three instruments were tested in their final form with children and adults unfamiliar with the program to see if the items and directions were appropriate. Copies of the three instruments are included in the appendix.

Time did not permit a full pilot test to check instrument reliability. Therefore, reliability statistics were computed using the responses of students participating in the study itself. Alpha reliabilities were found to be higher for the upper grades than for the younger students, as seen in the table below.

Table 1: Alpha Reliabilities by Unit and Measurement Scale*

	Unit One	Unit Two	Unit Three
Knowledge	.31	.60	.77
Attitude	.36	.69	.59
Participation	.29	.78	.77

*Data includes both pretest and posttests.

The lack of student familiarity with energy concepts reported by the kindergarten and first grade teachers undoubtedly reduced reliabilities. To help determine the influence of conceptual understanding on reliabilities, a separate analysis of Unit One pretests and posttests was completed for the demonstration students only. Pretest reliabilities of -.15, .31, and .20 for knowledge, attitude, and participation scales, respectively, rose on the posttest to .43, .65, and .44. Comparison student reliabilities averaged .20 on the pretest and .27 on the posttest. It seems clear that the clarification of energy concepts by studying the lessons improved the consistency of student responses, thereby raising the reliabilities. This point is also an indicator of the effectiveness of Unit One lessons.

The small number of items was another probable cause of low reliabilities of the Unit One test. The twenty items (scales of ten items, five items, and five items) will be increased in future uses of the test.

An indication of the construct validity of the attitude and participation scales was found using factor analysis. When all attitude and participation items were included in one factor analysis, the attitude items clustered on different factors than the participation items, indicating that two different constructs were being measured. With the exception of a very few items, this was true of the measures in all three units.

It was concluded on the basis of this evidence that, keeping the noted limitations in mind, the measurement instruments were adequate for the purposes of this preliminary study.

Implementation

The energy education consultant met with both teachers at each location to explain the tests, directions, procedures and purposes of the study. The teachers administered the pretests to their students. Two

weeks following the pretest, a call was made to each teacher to see if there were any concerns or problems. At the conclusion of the four week period, the consultant picked up the posttests, which had been administered by the teachers. Each teacher who used the lessons with the students was asked, "Did you teach at least one activity from each lesson, or if not, which ones did you omit?" All participants responded that they had taught at least one activity from each lesson. One teacher gave the consultant picture posters the students had drawn, and another showed a bulletin board and gave extensive notes to the consultant. Participants had suggestions for improvement in the tests and materials which indicated a familiarity with the impact of the lessons on students.

Limitations

Several limitations to this study should be kept in mind. Due to the press of time, a limited number of teachers and students participated in the study. Too few classes participated to allow the preferable technique of using classrooms as the unit of analysis. Students were the unit of analysis throughout the study. Also, as mentioned earlier, teacher volunteers were selected on the basis of locational variety rather than by a random selection. Therefore, we can not generalize the results to all teachers.

The evaluation instruments that were specifically designed for this study could not be pilot tested prior to their use; therefore, reliabilities were unknown. Subsequent use in the study revealed low reliabilities for K-1 students on the Unit One test. Although reliabilities were found to be higher among the K-1 students who studied the lessons, as discussed above, these weak reliabilities must be kept in mind when considering the results.

A further limitation is found in attempts to validate that the lessons were taught as requested in participating classrooms. Personal conversations with the participating teachers indicated that all lessons

were taught; further evidence of implementation was cited above. However, without systematic observation, little is known about the depth, intensity, or comprehensiveness of the instruction provided. Similarly, comparison class teachers agreed to avoid teaching about energy during the time of the study, but observational evidence again is lacking to confirm that energy was not discussed in the comparison classes. The effects of the drop in Iranian oil production and of a threatened gasoline dealers boycott during the time of the study may have prompted spontaneous instruction about energy in comparison classrooms.

Finally, because of the short duration of the study, time was insufficient to teach all eighteen lessons available at each level. Six lessons were selected for study. Therefore, caution should be used in interpreting the results of this study. The full effects of teaching all eighteen lessons await further study.

Results

Results of the study will be described by answering the three research questions in the order that they were described earlier. All analyses were completed using students as the unit of analysis.

- 1) Did students who studied the energy lessons differ significantly from comparison students on the knowledge test?

To answer this question, change scores were analyzed using analysis of covariance, with the pretest scores as the covariate. This procedure allows us to statistically equate the pretest scores of all students and then compare the change scores from pretest to posttest.

This comparison revealed that students who studied the energy lessons did significantly better than comparison students on the knowledge posttest. These significant differences in favor of the demonstration classes were found for Unit One ($p < .01$), for Unit Two ($p < .001$), and for Unit Three ($p < .01$).

Thus, a strong, positive impact on knowledge was found as a result of using the energy lessons. Furthermore, this positive impact was pervasive across all three units tested.

- 2) Did students who studied the energy lessons differ significantly from comparison students on the attitude measure?

Again, changes in attitude scores were analyzed using analysis of covariance. The comparison of adjusted posttest scores revealed a positive impact on student attitude scores as a result of using the lessons from Unit Two. The difference in favor of the demonstration classes was clearly significant ($p < .01$). No such difference was found as a result of using Unit One or Unit Three. Lack of differences in Unit One may be explained by the general reliability problems discussed earlier. Thus, while no pervasive impact can be claimed as in the case of knowledge, the potential for positive impact on attitudes was demonstrated by the significant increase in attitude scores among students studying the selected lessons from Unit Two.

- 3) Did students who studied the energy lessons differ significantly from comparison students on the participation measure?

The same statistical analysis used for the knowledge and attitude tests was carried out for the participation test. No significant differences were found in the participation measure as a result of studying any of the three units. This finding may be more related to the difficulty of measuring participation in the manner attempted than to the lack of influence of the lessons on student behavior. Problems of measuring participation with paper-and-pencil self-reports were discussed earlier.

It should be noted that an interesting correlation was observed between the attitude and participation measures for all students taking the test. Using the Pearson correlation procedure, attitude and participa-

tion scores were found to be significantly correlated for both demonstration and comparison classes, for both pretests and posttests, and for all three units. These correlations, five of which exceeded .50, can be seen in Table 2 below. The table also shows that among demonstration students, the average correlations went up between pretest and posttests, while among comparison students, the average correlations went down between tests. This indicates that students who studied the materials experienced an improved alignment between attitudes and participation. This is in contrast with the deterioration in the match between attitudes and participation noticed among the comparison students.

Table 2: PEARSON CORRELATIONS BETWEEN ATTITUDE AND PARTICIAPATION SCORES

Demonstration Students			Comparison Students		
	Pretest	Posttest		Pretest	Posttest
Unit One	.40**	.48***	Unit One	.66***	.27*
Unit Two	.57***	.38**	Unit Two	.64***	.35**
Unit Three	.27*	.52***	Unit Three	.44***	.55***
Average Correlation	.41	.46	Average Correlation	.58	.39

* $p < .05$
 ** $p < .01$
 *** $p < .001$

Conclusions and Significance

From the formative evaluation, it was concluded that the iterative procedure of panel review and pilot testing together produced beneficial results. In hindsight, the effects of the combined evaluation methods seem greater than the influence of either method taken separately. The interaction between the two activities resulted in clear specifications for revision of the preliminary materials. Although the two processes proceeded separately, information was gained from two different groups in a mutually reinforcing and timely manner. Others involved in early stages of curriculum development might consider this iterative procedure when there are serious time constraints.

Another benefit of this procedure was suggested by Welch (1979) in a review of science curriculum development efforts. He stated that results of classroom try-outs of new science materials had little effect on subsequent versions. Rather, decisions on revisions were based on debates among project staff who were usually scientists. He concluded that this limitation in the formative evaluation process explained the generally high difficulty level of most, if not all, of the newer curricula. Hopefully, the combination of two approaches has led to energy materials with more realistic expectations for students.

Given the constraints of time and money inherent in most development projects, it was concluded from this study that the formative evaluation efforts were more beneficial than the summative efforts. While the summative evaluation provided some evidence of the effectiveness of the materials, the formative evaluation provided information that immediately resulted in substantial changes. From a practical point of view, it would have been difficult to start the development process anew even if the summative results had been disappointing. Others would be well

advised to give high priority to formative efforts since the impact on the actual materials is much greater.

The questionnaires used to study teacher outcomes were designed to provide a broad, rather than a deep, look at the use of the materials and at how teachers perceive the materials. Several conclusions can be drawn from the results:

1. The materials made a positive first impression at the initial demonstration workshops, an impression which was subsequently fulfilled as teachers used the lessons.
2. The materials met a perceived need expressed at the initial dissemination workshop for energy materials to use in the classroom. Teachers generally felt that the materials fit their curriculum, were appropriate to the backgrounds and abilities of students, were interesting to students, and influenced attitudes about energy.
3. The lessons were used by a large majority of those who were introduced to them at the initial workshops. The adaptations for mathematics and language arts, however, were used by only a small minority of teachers, with language arts ideas being used more than mathematics ideas. The reasons for this can not be determined without a further study using interview techniques.
4. A large majority of responding teachers enjoyed using the lessons and shared the materials with several other teachers.

The use of three questionnaires to study teacher outcomes was a broad effort to ascertain the use of materials by all teacher attending the workshops. While this approach appeared to be a useful means of drawing general conclusions, it did little to improve understanding of the actual

day-to-day implementation processes in classrooms. A companion study of teacher implementation utilizing interviews and classroom observations is needed to answer questions such as, "What kind of lesson modifications were made by teachers?" or "How did teachers sequence lessons for use with students?" This type of study would add a dimension that cannot be adequately captured by questionnaires.

While the student impact study was small and had a number of limitations as described earlier, some encouraging conclusions were drawn about the potential usefulness of An Energy Curriculum for the Elementary Grades:

- 1) Studying the energy lessons resulted in a significant gain in energy knowledge. This gain was consistent for all three units. Thus, the lessons appear to be very useful in helping students learn about energy and energy problems.
- 2) Studying the energy lessons resulted in a significant gain on the attitude measure for Unit Two. While this gain was not found for the other two units, we can conclude from the experience with Unit Two that studying the energy lessons can potentially develop more positive energy attitudes among students.
- 3) While studying the energy lessons had no general impact on the participation measure, an improved correlation was found between attitudes and participation as a result of studying the lessons. Among comparison students, in contrast, the correlation between attitudes and participation decreased over the period of the study. Thus, studying the lessons may be an influence to help students align their attitudes with their participation in the areas of energy.

The results of the student study showed an encouraging degree of effectiveness with students. While further studies with larger numbers

of classes would help answer several lingering questions, considerable evidence was available in this study which would recommend the use of these lessons by elementary educators who wish to teach about energy in their classrooms.

Overall, the predominantly positive results seen in both the teacher outcomes and the student outcomes lead to the general conclusion that the formative evaluation efforts were effective. In addition, the positive results related to both teachers and students provide broad evidence that the energy materials can be useful tools for teachers who wish to provide effective instruction about energy. In the retrospective opinion of the evaluators, both teacher and student studies were necessary to assess the impact of the materials. It is recommended that others consider the dual strategy since it is conceivable that the separate results may not be mutually reinforcing.

Energy education is a relatively new curricular area arising in response to an acute societal problem. Only a few evaluation efforts on this topic have been reported (Battelle, 1979; Niedermeyer and Roberson, 1979). In quickly implemented projects, temptations are strong to slide over evaluation efforts in the rush to completion. The conclusions stated here demonstrate that valuable evaluation information, both formative and summative, can be obtained through appropriately designed evaluation efforts without hindering tight timelines.

Observations

State departments of education often address a pressing social problem by developing materials that will be used on a voluntary and supplemental basis. Frequently, funding agencies or urgent need imposes serious time constraints. Evaluators are then posed with the choice of evaluating one aspect of the project in depth or evaluating the total impact of the project with less depth.

This paper reported on one effort to evaluate voluntary and supplemental materials both formatively and summatively. Outcomes for both students and teachers were studied. Although the numbers of students and teachers were small in all aspects of the evaluation, valuable conclusions were reached and communicated to the intended audiences.

It would appear useful at this point to consider evaluation approaches used in similar efforts such as career education, drug education, or arts education. In these areas, as in energy education, decisions must be made about the amount of money and time to invest in evaluation. Some situations seem to require rigorous data collection regardless of the cost in time, money, or inconvenience to participants. Perhaps other state department personnel have found that in-depth, systematic, expensive evaluation of all aspects of a project is not possible or does not produce results in time to influence on-going decisions. If this is the case, it would appear likely that broad based evaluation efforts with less depth, such as those described in this paper, would be useful. Timeliness was a crucial factor in both the formative and summative phases of this evaluation. One definition of a successful evaluation in a state education agency is to have adequate evaluative data available at the time decisions are made. The broad based design chosen for this evaluation made it possible to meet the necessary deadlines.

Another interesting and informative aspect of the evaluation described above is the way the summative results were communicated to the intended audiences. In state education agencies, as in other institutions, evaluation results are most useful when reported in a form that is geared to the intended audience. In the case of this evaluation effort, the results were reported in a variety of ways.

A formal report, A Study of the Impact of Selected Lessons from the Energy Education Curriculum on Students (1979), was prepared for the funding agency and for energy educators, so they would be fully informed about both procedures and results. A separate briefing report about the student and teacher outcomes was prepared for the Indiana Commission on General Education since it was felt that this audience would be interested in a brief summary report of only the results. A press release highlighting the General Commission report was sent to all media in the state and was reported widely in newspapers, and on radio and television. The press release included responses to individual questions as well as general results so that it would "come alive" for the general public. When the complete publication, An Energy Curriculum for the Elementary Grades, was mailed to all school superintendents, a letter describing the student impact study was enclosed. Finally, this paper and possible articles to appear in professional journals have been geared to the interests of educators interested in energy and evaluation. In this project, the evaluators felt that the extra effort to prepare a variety of reports was worthwhile since all of the audiences would have some impact on the future of energy education.

References

An energy curriculum for the elementary grades. Indianapolis, Indiana: Indiana Department of Public Instruction, 1979.

Battelle, Review and evaluation of DOE energy education curriculum materials. Washington, D.C.: U.S. Department of Energy, 1979.

Niedermeyer, Fred and Roberson, Ernest. Captain Power and Power Quiz: Two new energy programs. The Elementary School Journal. 79 (May, 1979), 259-268.

Schaffarzick, Jon and Hampson, David (Eds.). Strategies for curriculum development. Berkeley, California: McCutchan Publishing Corp., 1975.

Steele, Sara. Contemporary approaches to program evaluation: Implications for evaluation programs for disadvantaged adults. Washington, D.C.: Capital Publications, Inc., 1977.

Smith, Victor and Lane, Kathleen. A study of the impact of selected lessons from the elementary energy curriculum on students. Indianapolis, Indiana: Indiana Department of Public Instruction, 1979.

Welch, Wayne M. Twenty years of science curriculum development: A look back. In David Berliner (Ed.), Review of Research in Education. American Educational Research Association. 1979, 282-306.

APPENDIX

INSTRUMENTS USED IN THIS STUDY:

- 1) Lesson Response Form for Teachers
(Formative Evaluation)
- 2) General Response Form for Teachers
(Formative Evaluation)
- 3) Workshop Evaluation Form
- 4) Follow-up Questionnaire
- 5) Student Energy Surveys: Unit I, II and III

ENERGY EDUCATION CURRICULUM PROJECT

TEACHER _____
SCHOOL _____
PHONE _____

LESSON RESPONSE

Name of Lesson _____

Grade of Students _____

1. Were the objectives of the lesson clear to you? _____
Comments: _____

2. Did the students meet the learning objectives? _____
Which type of students met the learning objectives?
_____ Higher ability Comments: _____
_____ Average ability
_____ Lower ability

3. Did the students respond with interest? _____
Which type of students were interested in the materials?
_____ Higher ability Comments: _____
_____ Average ability
_____ Lower ability

4. Were the materials appropriate in reading level? _____
For what reading level were they appropriate?
_____ Higher ability Comments: _____
_____ Average ability
_____ Lower ability

5. How long did the lesson take? Was this too long, too short,
or just right? _____

6. What are the strengths of this lesson? _____

7. What are the weak points? _____

8. What changes would you suggest? _____

9. Did you supplement the lesson with other materials or test
questions? _____

Could you share a copy of these materials with us? _____

10. Other comments: _____

Please use the back of this sheet for additional comments.

ENERGY EDUCATION CURRICULUM PROJECT

TEACHER _____

SCHOOL _____

GENERAL RESPONSE

1. Would you like to use these lessons again? _____

2. Are lessons like this on energy needed at the elementary level? _____

3. How many lessons like these would you like to have available for your grade level? _____

4. How would you use lessons like this if more were available? Altogether in a unit? Interspersed with other subjects? Once a week? _____

5. Would lessons like this fit best into your social studies curriculum or your science curriculum? _____

6. What general suggestions do you have for teaching elementary students about energy? _____

7. What signs, if any, indicated to you that student awareness of energy problems has increased as a result of these lessons? _____

8. Other comments: _____

ENERGY EDUCATION WORKSHOP EVALUATION - Page 2

What did you like best about the workshop? _____

What did you like least about the workshop? _____

Suggestions and Comments: _____

FOLLOW-UP INFORMATION - Please check all statements that apply.

- _____ 1. I will use these materials in my teaching.
- _____ 2. I would like to receive other EECF elementary materials as they become available.
- _____ 3. I would like to have my students participate in the student evaluation of these materials.
- _____ 4. I would like to be contacted about other energy-related workshops.
- _____ 5. I would like to facilitate an energy education workshop for my school or school corporation.

Name _____ Position _____

School Address _____ Grade Level _____

NAME _____

(1-3)

GRADE TAUGHT _____

(4)

NAME OF SCHOOL _____

(5-8)

Part I. Please answer each question below by checking the appropriate blank.

1. In what subject area have you primarily taught the lessons from the Energy Curriculum Project. (Check only one). (9)

(1) _____ Social Studies (4) _____ Other
(2) _____ Science (5) _____ None
(3) _____ Social Studies/Science

2. Approximately how much time did you spend teaching lessons from the Energy Education Curriculum Project during 1978-79? (10)

(1) _____ 0 hours (4) _____ 7-9 hours
(2) _____ 1-3 hours (5) _____ 10 or more hours
(3) _____ 4-6 hours

3. Approximately how much time did you spend during the past school year teaching about energy in addition to the time you taught lessons from the Energy Education Curriculum Project? (11)

(1) _____ 0 hours (4) _____ 7-9 hours
(2) _____ 1-3 hours (5) _____ 10 or more hours
(3) _____ 4-6 hours

4. During this past school year, have you shared any of the materials you received at the energy workshop with other teachers at your school? (12)

(1) _____ No (5) _____ Yes, with 5-10 others
(2) _____ Yes, with 1 other (6) _____ Yes, with 11 or more others, but
(3) _____ Yes, with 2 others not the entire staff
(4) _____ Yes, with 3-4 others (7) _____ Yes, with the entire staff

5. During this past school year, have you used the math adaptations included with the lessons from the Energy Education Curriculum Project? (13)

(1) _____ No (4) _____ Yes, with 3 lessons
(2) _____ Yes, with 1 lesson (5) _____ Yes, with 4 lessons
(3) _____ Yes, with 2 lessons (6) _____ Yes, with over 4 lessons

6. During this past school year, have you used the language arts adaptations included with lessons from the Energy Education Curriculum Project? (14)

(1) _____ No (4) _____ Yes, with 3 lessons
(2) _____ Yes, with 1 lesson (5) _____ Yes, with 4 lessons
(3) _____ Yes, with 2 lessons (6) _____ Yes, with over 4 lessons

7. Please put a check in each "yes" or "no" column indicating whether you have (15-26)
or have not used Energy Education Curriculum Project sample lessons with
your students.

	YES (1)	NO (2)
Lesson 1-1 What is Person Power?	_____	_____
Lesson 2-2 Energy in Your Classroom	_____	_____
Lesson 2-4 Energy in Your Home	_____	_____
Lesson 3-3 People Solving Energy Problems	_____	_____
Lesson 1-1 Community Energy	_____	_____
Lesson 1-4 People Who Help Others	_____	_____
Lesson 2-4 Wasting Energy	_____	_____
Lesson 3-2 People's Energy Habits	_____	_____
Lesson 1-1 Energy Coming and Going	_____	_____
Lesson 2-2 Energy Actors	_____	_____
Lesson 2-6 Energy and Your Values	_____	_____
Lesson 3-1 Taking Your Own Action	_____	_____

8. During this past school year, have you requested or ordered instructional (27)
materials about energy other than materials from the Energy Education
Curriculum Project?

(1) _____ Yes
(2) _____ No

Part II. Read each question and circle the number which best reflects your answer.
Responses can range from "Definitely No" (1) to "Definitely Yes" (7).

	<u>DEFINITELY</u> <u>NO</u>		<u>NEUTRAL</u>				<u>DEFINITELY</u> <u>YES</u>		
9. Do other teachers in your building support teaching lessons about energy?	1	2	3	4	5	6	7	(28)	
10. Are the goals of the Energy Education Curriculum Project lessons in line with the major curricular goals of your district?	1	2	3	4	5	6	7	(29)	
11. Was the workshop useful as an introduction to the lessons from the Energy Education Curriculum Project?	1	2	3	4	5	6	7	(30)	
12. Are you likely to use these energy lessons next year?	1	2	3	4	5	6	7	(31)	
13. Does your community support teaching lessons about energy?	1	2	3	4	5	6	7	(32)	
14. In general, are the energy lessons appropriate for the abilities of your students?	1	2	3	4	5	6	7	(33)	

	<u>DEFINITELY</u> <u>NO</u>			<u>NEUTRAL</u>			<u>DEFINITELY</u> <u>YES</u>	
15. Does your principal support teaching lessons about energy?	1	2	3	4	5	6	7	(34)
16. In general, are the energy lessons relevant to the backgrounds of your students?	1	2	3	4	5	6	7	(35)
17. Is energy education more important to you now than it was last fall?	1	2	3	4	5	6	7	(36)

If you have not taught any of the lessons from the Energy Education Curriculum Project, please go on to number 22.

18. Have the energy lessons affected the energy attitudes of your students?	1	2	3	4	5	6	7	(37)
19. Did you modify the lessons about energy?	1	2	3	4	5	6	7	(38)
20. Did you enjoy teaching the lessons from the Energy Education Curriculum Project?	1	2	3	4	5	6	7	(39)
21. Did your student react favorably to the energy lessons?	1	2	3	4	5	6	7	(40)

Part III. Follow the directions in each question.

22. How important do you think the following topics are for your teaching? Circle the number which indicates the importance of each topic.

	<u>NOT</u> <u>IMPORTANT</u>			<u>NEUTRAL</u>			<u>EXTREMELY</u> <u>IMPORTANT</u>	
Energy Conservation	1	2	3	4	5	6	7	(41)
The Specifics of Energy Production and Use	1	2	3	4	5	6	7	(42)
The Social Implications of Energy	1	2	3	4	5	6	7	(43)
The Economics of Energy	1	2	3	4	5	6	7	(44)

23. Please rank the same topics according to your priorities (1 = highest, 4 = lowest).

_____ Energy Conservation	(45)
_____ The Specifics of Energy Production and Use	(46)
_____ The Social Implications of Energy	(47)
_____ The Economics of Energy	(48)

24. Rank the seven major problems listed below in terms of what you consider to be their importance in society (1 = highest, 7 = lowest). (49-55)

_____ Crime	_____ Energy
_____ Inflation	_____ Defense
_____ Health	_____ Unemployment
_____ Education	

25. Do you believe we currently have a real shortage of energy? (56)

1. _____ Yes
2. _____ No

26. Do you believe we are likely to have a real energy shortage sometime during the 1980's? (57)

1. _____ Yes
2. _____ No

27. Which do you feel is the best estimate of when the world demand for petroleum will surpass the world supply of petroleum? (58)

1. _____ 1980's	4. _____ After 2025
2. _____ 1990's	5. _____ Never
3. _____ Between 2000 and 2025	

28. There is widespread disagreement among citizens as to whether they can have any effect on government and private decisions on energy. Do you believe you can have an effect on energy policies by: (59-66)

	YES (1)	NO (2)
Writing to Energy Department Officials?	_____	_____
Being an activist at the local level?	_____	_____
Boycotting selected energy procedures?	_____	_____
Writing to your member of Congress?	_____	_____
Lobbying your state government?	_____	_____
Writing directly to energy companies?	_____	_____
Asking candidates questions about energy?	_____	_____
Educating friends and fellow workers?	_____	_____

STUDENT ENERGY SURVEY

UNIT I

This survey of knowledge, skills, attitudes and participation habits will be used as a pretest and a posttest. Student answer sheets are enclosed. This survey is designed to measure student growth and includes the main ideas from the lessons you will be teaching.

There are three parts to this survey. The first part assesses knowledge and skills, and the second part assesses attitudes about energy conservation. The third section focuses on habits of participation regarding energy conservation. Since two answer sheets are required, you may want to give Section I at one time and Sections II and III at another time.

Teacher Directions:

Section I

1. Pass out one answer sheet after students have pencils on their desks. Ask them to put their paper face down.
2. Tell students to put their names on the back of the paper. Demonstrate.
3. Tell students that this is an activity to see how much they know about energy and how they feel about energy.
4. Tell them you are going to read a phrase and they should put an X over the sad or happy face. They should mark the sad face if they want to mark "no". They should mark the happy face if they want to mark "yes". Demonstrate on the blackboard.
5. Ask them to turn their papers over and to look at the first row marked "EXAMPLE". Read the following practice item:

"Cars Use Energy".

Tell students that if they want to say "no" to this statement, they should put an X on the sad face. If they want to mark "yes" to this statement, they should put an X on the happy face. Check to see if each student has put an X on a happy face or sad face.

6. Start with Number 1. Have every child put his finger on the number 1.
7. Read the first statement. Repeat. Do not reword the statements or answer questions about the statements. Check to see that all students have put an X on one face in the box for number 1.
8. Repeat the procedure by having each student put his or her finger on the next number. Repeat the statement twice and move on to the next one until all items are completed. Collect papers. Please add the student's last name on the back of the paper if they have not done so.

Section II and Section III

Repeat the above procedure for Section II and Section III. Students will need another answer sheet. Again, make sure they put an X on a happy or sad face.

ENERGY - UNIT I

Section I: Knowledge & Skills

- | | |
|--|-----|
| 1. We use very little energy in our homes. | no |
| 2. I am an energy user. | yes |
| 3. TVs and stoves are energy products. | yes |
| 4. Each of us can help with energy problems. | yes |
| 5. Each of us has human energy. | yes |
| 6. There are many energy products in our classroom. | yes |
| 7. A good energy question is clear and related to the problem. | yes |
| 8. I get very little energy from eating. | no |
| 9. I use human energy when I play. | yes |
| 10. We never run out of human energy. | no |

Section II: Attitudes

1. I can help solve energy problems.
2. It is OK to use lots of energy.
3. I should take care of my own energy.
4. I want to change the way I do things to save energy.
5. I want to learn more about saving energy.

Section III: Participation

1. I throw things away before they are used up.
2. I have asked a friend to save energy.
3. I waste energy in my home.
4. I use paper on both sides.
5. I turn the lights off in my home when I do not need them.

Example

Section I: Knowledge & Skills



2.



4.



6.



8.



10.



Example



2.



4.



6.



8.



10.



STUDENT ENERGY SURVEY

UNIT II

This assessment of knowledge, skills, attitudes and participation habits will be used as a pretest and a posttest. A copy of the assessment is enclosed. This survey is designed to measure student growth and includes the main ideas from the lessons you will be teaching.

There are three parts to this survey. The first part assesses knowledge and skills, and the second section assesses attitudes about energy conservation. The third section focuses on habits of participation regarding energy conservation.

Teacher Directions:

Section I

1. Read the directions for the first section of the test aloud to the class.
2. Demonstrate on the board how students should mark their answers.
3. Go over the example to make sure students understand that they should circle the best answer.
4. Read each question as the students do. Do not reword the items or answer questions about items.
5. Continue until all fifteen items are completed.
6. The correct answers are circled on your copy of the test, but please do not give the students the correct answers after the pretest.

Section II and Section III

Repeat the above procedure for Section II, then Section III. Make sure the students understand these directions as they are different from those for the first section. They should put an X on the face that is true about them in these two sections.

Section I: Knowledge & Skills

- DIRECTIONS:
1. You will be answering some questions to see how much you know about energy.
 2. Read these directions silently while your teacher reads them aloud.
 3. After each statement, circle the letter of the BEST answer.
 4. Here is a practice item. Circle the letter of the BEST answer.

People get energy from

- A. food.
- B. books.
- C. toys.

Food is the BEST answer, so circle A.

5. Ask your teacher if you need help.

-
1. Janet had a flat tire on her bike. She decided to patch it instead of buying a new tire. This is an example of
 - A. wasting objects.
 - B. conserving products.
 - C. using alternatives.
 2. A lot of energy is conserved when we
 - A. keep our homes hot.
 - B. use air-conditioners.
 - C. drive small cars.
 3. Tina rides the bus to school. However, she often oversleeps and asks her mother to drive her to school. This is an example of
 - A. conserving energy.
 - B. wasting energy.
 - C. using energy alternatives.
 4. Which of these is often recycled?
 - A. cans
 - B. candy wrappers
 - C. pens

5. After one bite, Tom decided not to eat his oatmeal because he did not like it. This is an example of
 - A. wasting a source of human energy.
 - B. conserving a source of human energy.
 - C. using an alternative source of human energy.
6. Joan talked to her ball team about walking to the baseball field. They usually ride in a car. The team decided to walk. In this example, Joan
 - A. gathered facts about saving energy.
 - B. asked her team questions about saving energy.
 - C. convinced her team to save energy.
7. Which of the following is the best way to conserve energy?
 - A. driving slower
 - B. driving bigger cars
 - C. turning the thermostat up
8. One example of an energy alternative is
 - A. water power.
 - B. fossil fuel.
 - C. solar energy.
9. Which is an example of waste?
 - A. throwing out good food
 - B. fixing toys that are broken
 - C. recycling bottles and cans
10. Which is the best example of an energy conservation question?
 - A. Can I afford this product?
 - B. Can this product be recycled?
 - C. Does my friend have this product?
11. Energy can be saved by
 - A. driving faster.
 - B. turning lights off.
 - C. using more paper.
12. Which of these activities does NOT show energy conservation?
 - A. I do not like this toy anymore. I'll throw it away.
 - B. Let's save our paper bags. They can be used again.
 - C. Let's buy pop in glass bottles. They can be recycled.
13. Which of the following is an example of waste?
 - A. returning bottles to the store
 - B. using paper on one side
 - C. recycling cans

14. An example of a good "Energy Waster Question" would be

- A. Can I afford this product?
- B. Is this color my favorite?
- C. Do I really need this product?

15. Fossil fuels are important energy

- A. sources.
- B. savers.
- C. users.

STOP UNTIL YOUR TEACHER TELLS YOU TO GO ON.

Section II & Section III: Attitudes & Participation

- DIRECTIONS:
1. You will be reading some statements to see how you feel about energy.
 2. Read these directions silently while your teachers reads them aloud.
 3. After each statement, put an X on the face that is true about you. There are five answers to choose from.

If you strongly disagree, put an X on the face that looks like this.



NO!

If you disagree, put an X on the face that looks like this.



no

If you partly agree or are not sure, put an X on the face that looks like this.



sometimes

If you agree, put an X on the face that looks like this.



yes

If you strongly agree, put an X on the face that looks like this.



YES!

EXAMPLES:

I want to eat better food.



NO!



no



sometimes



yes



YES!

I like to ride in a car.



NO!



no



sometimes



yes



YES!

If you have questions, ask your teacher.

Section II: Attitudes

1. I want to change my habits to save energy.



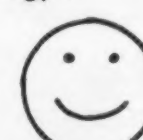
NO!



no



sometimes

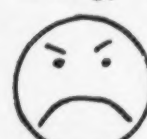


yes



YES!

2. Energy habits are important to me.



NO!



no



sometimes



yes



YES!

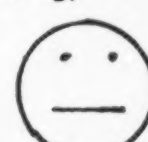
3. It is OK to use lots of energy.



NO!



no



sometimes



yes



YES!

4. I would rather travel by car than walk a short distance.



NO!



no



51

sometimes



yes



YES!

5. I can help solve energy problems.



NO!



no



sometimes



yes



YES!

6. Adults will take care of energy problems.



NO!



no



sometimes



yes



YES!

7. I want to learn more about good energy habits.



NO!



no



sometimes



yes



YES!

8. I should take care of my own energy.



NO!



no



sometimes



yes



YES!

Section III: Participation

1. I use paper on both sides.



NO!



no



sometimes



yes



YES!

2. I leave the TV on in my home when no one is watching it.



NO!



no



sometimes



yes



YES!

3. I have tried to convince a friend to save energy.



NO!



no



sometimes



yes



YES!

4. I have asked someone to turn down the heat to save energy.



NO!



no



sometimes



yes



YES!

5. I recycle bottles and cans.



NO!



no



sometimes



yes



YES!

6. I leave lights on in my home when I do not need them.



NO!



no



sometimes



yes



YES!

7. I waste energy in my home.



NO!



no



sometimes



yes



YES!

STUDENT ENERGY SURVEY

UNIT III

This survey of knowledge, skills, attitudes and participation habits will be used as a pretest and posttest. A copy of the assessment is enclosed. This survey is designed to measure student growth and includes the main ideas from the lessons you will be teaching.

There are three parts to this survey. The first part assesses knowledge and skills, and the second section assesses attitudes about energy conservation. The third section focuses on habits of participation regarding energy conservation.

Teacher Directions:

Section I

1. Read the directions for the first section of the test aloud to the class.
2. Demonstrate on the board how students should mark their answers.
3. Go over the example to make sure students understand that they should circle the best answer.
4. Please do not answer questions about the items.
5. The correct answers are circled on your copy of the test, but please do not give the students the correct answers after the pretest.

Section II and Section III

Repeat the above procedure for Section II and Section III. Make sure the students understand these directions as they are different from those for the first section. They should circle the response that is true about them in these two sections.

Section I: Knowledge & Skills

- DIRECTIONS:
1. You will be answering some questions to see how much you know about energy.
 2. Read these directions silently while your teacher reads them aloud.
 3. After each statement, circle the letter of the BEST answer.
 4. Here is a practice item. Circle the letter of the BEST answer.

People get energy from

- A. food.
- B. books.
- C. toys.
- D. minerals.

Food is the best answer, so circle A.

5. Ask your teacher if you need help.

-
1. Which of the following is a problem associated with solar energy?
 - A. Setting up a solar energy system is expensive.
 - B. Setting up a solar energy system is dangerous.
 - C. Solar waste disposal is difficult.
 - D. Solar energy creates environmental pollution.
 2. Students have been asked to gather evidence about an energy source. Which of the following activities would be of the LEAST help?
 - A. looking at books and magazines
 - B. interviewing a knowledgeable person
 - C. visiting a place which produces energy
 - D. drawing a picture about energy.
 3. The main source of human energy is
 - A. minerals.
 - B. electricity.
 - C. food.
 - D. water.
 4. An alternative energy source is
 - A. water.
 - B. nuclear.
 - C. coal.
 - D. gasoline.

5. Fossil fuels come from
- A. beneath the earth.
 - B. the water.
 - C. the earth's topsoil.
 - D. the air.
6. Students are asked to describe what would happen if people did not have enough food in the future. This process is an example of
- A. forecasting.
 - B. valuing.
 - C. talking.
 - D. rationing.
7. Students could find out more information about solar energy by
- A. writing a poem about the sun.
 - B. looking in a book about the sun.
 - C. drawing a picture of the sun.
 - D. looking at the sun.
8. Oil and natural gas are examples of
- A. nuclear fuels.
 - B. car fuels.
 - C. fossil fuels.
 - D. renewable fuels.
9. Coal, an energy source, is mined, refined, and moved to a plant where it is used to make electricity. Which of the following best describes this entire process?
- A. energy transformation
 - B. energy transportation
 - C. energy mining
 - D. energy products
10. Which of the following is NOT true when talking about fossil fuels?
- A. They are non-renewable.
 - B. They are extracted from beneath the earth.
 - C. They are transformed into energy and energy products.
 - D. They are in abundant supply.
11. As an energy source, water is most commonly used to produce
- A. fossil fuels.
 - B. electrical energy.
 - C. human energy.
 - D. solar energy.
12. A poor diet can result in
- A. less human energy.
 - B. more human energy.
 - C. better health.
 - D. conservation.

13. Which of the following is a problem associated with nuclear energy?
- A. Nuclear energy can cause a cooling of the water supply.
 - B. Clouds can cause a lack of direct sunrays.
 - C. Disposal of nuclear waste is difficult.
 - D. Nuclear energy results in air pollution.
14. An example of a fossil fuel is
- A. coal.
 - B. wind.
 - C. nuclear.
 - D. water.
15. Which fact illustrates energy transformation?
- A. We use energy sources.
 - B. We use energy products.
 - C. We use energy to change energy sources into energy.
 - D. We use energy to change energy products into energy sources.
16. Which is an example of human energy transformation?
- A. Oil is transformed into gasoline.
 - B. Food is transformed into energy.
 - C. Water power is transformed into electricity.
 - D. Water power is transformed into energy.
17. Wind, water and wood are examples of
- A. fossil fuels.
 - B. energy sources.
 - C. car fuels.
 - D. food sources.
18. A calorie is a measure of the energy produced by
- A. lights.
 - B. coal.
 - C. food.
 - D. oil.
19. Wind, water and wood are
- A. renewable energy sources.
 - B. non-renewable energy sources.
 - C. solar fuels.
 - D. fossil fuels.
20. Oil is found in which of the following products?
- A. filing cabinets.
 - B. bricks
 - C. wool coats
 - D. plastics

Section II and III: Attitudes & Participation

- DIRECTIONS:
1. You will be reading some statements to see how you feel about energy.
 2. Read these directions silently while your teacher reads them aloud.
 3. After each statement, circle the answer that is true about you. There are five answers to choose from.

If you strongly disagree, circle "NO!".

If you disagree, but not strongly, circle "no".

If you partly agree or are not sure, circle "sometimes".

If you agree, but not strongly, circle "yes".

If you strongly agree, circle "YES!".

EXAMPLES:

I want to have a well balanced meal. NO! no sometimes yes YES!

I want to learn more about solar energy. NO! no sometimes yes YES!

4. If you have any questions, ask your teacher for help.

Section II: Attitudes

- | | | | | | |
|--|-----|----|-----------|-----|------|
| 1. It is OK to use lots of energy. | NO! | no | sometimes | yes | YES! |
| 2. I would rather travel by car than walk a short distance. | NO! | no | sometimes | yes | YES! |
| 3. Energy habits are important to me. | NO! | no | sometimes | yes | YES! |
| 4. Adults will take care of energy problems. | NO! | no | sometimes | yes | YES! |
| 5. If we run out of energy sources, someone will find more. | NO! | no | sometimes | yes | YES! |
| 6. I should conserve my own energy. | NO! | no | sometimes | yes | YES! |
| 7. I want to learn more about good energy habits. | NO! | no | sometimes | yes | YES! |
| 8. I want to change my habits to save energy. | NO! | no | sometimes | yes | YES! |
| 9. It is unfair to have to turn down my heat just to save energy for someone else. | NO! | no | sometimes | yes | YES! |
| 10. I can help solve energy problems. | NO! | no | sometimes | yes | YES! |

Section III: Participation

1. I have tried to convince a friend to save energy.	NO!	no	sometimes	yes	YES!
2. I have asked someone to turn down the heat to save energy.	NO!	no	sometimes	yes	YES!
3. I leave the TV on in my home when no one is watching it.	NO!	no	sometimes	yes	YES!
4. I ride my bicycle to save gasoline.	NO!	no	sometimes	yes	YES!
5. I have asked someone to drive 55 m.p.h. to save gasoline.	NO!	no	sometimes	yes	YES!
6. I waste energy in my home.	NO!	no	sometimes	yes	YES!
7. I leave lights on in my home when I do not need them.	NO!	no	sometimes	yes	YES!
8. I use paper on both sides.	NO!	no	sometimes	yes	YES!
9. On my own, I have read a book or magazine about energy.	NO!	no	sometimes	yes	YES!
10. I recycle bottles and cans.	NO!	no	sometimes	yes	YES!